Exploring Public Perceptions of Benefits and Risks, Trust, and Acceptance of Nuclear Energy in Thailand and Vietnam: A Qualitative Approach

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Abstract

Understanding public perception is critical to developing effective policies for nuclear energy. This study conducted focus group discussions with the Thai and Vietnamese public to understand their trust in potential stakeholders, benefit perception, risk perception, and acceptance of nuclear energy. The participants in both countries preferred economic benefits, such as boosting national development to environmental benefits. Participants perceived nuclear accidents as a major risk, but such perceptions were sometimes based on misunderstandings. The findings suggested that participants evaluated trust toward relevant stakeholders based on their expertise, transparency, and empathy. Overall, participants indicated that their respective countries were not ready for nuclear energy: The Thais thought that their government should heighten public education on nuclear energy, while the Vietnamese thought that their country lacked expertise for managing nuclear power plants. This study also highlights the theoretical and policy implications for nuclear energy development in Southeast Asia. Directions for future studies were discussed.

Keywords: nuclear energy; public perception; Thailand; Vietnam; focus group; trust

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1. Introduction

The civil use of nuclear energy has been a controversial topic among the public (Ho, 2016; World Nuclear Association [WNA], 2015). Nu clear energy has earned widespread recognition as a pragmatic solution to mitigate global climate change as it emits a significantly reduced amount of carbon dioxide than conventional energy sources such as fossil fuels (WNA, 2015). Nuclear energy has also been associated with job creation and economic growth (Lohr, 2010). Advocates have also touted nuclear energy as a solution for addressing the rising energy demands by providing a stable and large supply of electricity (WNA, 2015). In spite of these benefits, people still regard nuclear energy as a risky technology: If a nuclear accident were to occur, a large amount of radioactivity could be dispersed into the atmosphere (Hodgson, 2010; WNA, 2015) and detrimentally impact the environment as well as human health. Critics have also highlighted potential issues surrounding nuclear energy development, such as improper radioactive waste management, insufficient safety regulations, substantial costs, and weaponization of nuclear technologies (International Atomic Energy Agency [IAEA], 2016; WNA, 2015). Among the potential risks associated with nuclear energy, sentiments of opposition primarily stem from the occurrence of nuclear accidents. For instance, the 2011 Fukushima nuclear accident dampened public support for nuclear energy and triggered a decline in the number of operating reactors in Europe (Brown et al., 2015).

Despite the declining trend of nuclear energy adoption and development in countries such as Italy (Faris, 2011) and Germany (Staudenmaier, 2017), nuclear energy adoption and development is expected to increase in Asia due to a surge in electricity demands in the region (WNA, 2016). In particular, countries in Southeast Asia (SEA) have considered the

possibility of nuclear power as part of their energy portfolio (Zuhairah, 2016). While there are no immediate plans for constructing a nuclear power plant, some SEA countries such as Thailand and Indonesia, have been conducting preparatory work for the civil use of nuclear energy (IAEA, 2018).

In light of the heightened regional salience of nuclear energy in recent years, it is important to understand and accurately assess public perceptions toward nuclear energy. Public perception plays a crucial role in determining whether a country will incorporate nuclear energy into the national policies for electricity production (Goodfellow et al., 2011). In 1976, the Thai government abandoned its plans to construct its first nuclear power plant due to strong public opposition (Praiwan, 2017; Wangkiat, 2016). More recently, Vietnam's nuclear development plans were halted due to public concerns about nuclear accidents and financial issues (South China Morning Post, 2017). Considering how public opinion may facilitate or obstruct plans for nuclear energy development, it is imperative for policymakers to engage the public when formulating and implementing policies regarding controversial science issues (Besley and Nisbet, 2013; Su et al., 2016). In addition, scientists and the public often do not share similar views or values about scientific issues (Su et al., 2016). Therefore, a consultative approach that considers a wide spectrum of viewpoints may assist policymakers in making democratic and effective policy decisions on contentious science issues (Burstein, 1998).

Despite the rising regional salience of nuclear energy, there is a dearth of academic literature examining public perceptions of nuclear energy in SEA. A recent meta-analytic study by Ho et al. (2018a, 2018b) revealed that public opinion studies on nuclear energy were mostly conducted within industrialized countries in North America, Europe, and East Asia, where nuclear energy has been deployed for years. In comparison, few studies have examined public perceptions in countries that are in the preliminary stages of nuclear energy

development. Since the public in these countries may possess limited nuclear knowledge (Ho, 2016), it would be worthwhile to investigate public perceptions in SEA countries that are contemplating whether to include nuclear in their energy mix.

This study aims to understand public perceptions of benefits and risks associated with nuclear energy development in Thailand and Vietnam. Moreover, this study seeks to examine the public's credibility perceptions of various nuclear-related organizations in Thailand and Vietnam. In addition, this study aims to gauge the public's level of acceptance for nuclear energy in Thailand and Vietnam. Theoretically, the results obtained from this study may contribute to extant literature by assessing public perceptions of nuclear energy development in an under-studied cultural context. Practically, this study may inform policymakers about the misconceptions about nuclear energy development that are highly prevalent in Thailand and Vietnam. By obtaining an in-depth understanding about the public's perceptions and concerns, this study may also assist policymakers in formulating effective communication campaigns about nuclear energy development. Moreover, the findings may help nuclear-related organizations in Thailand and Vietnam formulate strategies to enhance public trust.

1.1. Study context

The current study aims to fill the research gap by reviewing public perceptions of nuclear energy in two SEA countries — Thailand and Vietnam — using a series of focus group discussions (FGDs). We focused on these countries because they share similar records of nuclear development, yet are at different deployment stages due to their respective political and energy situations: Both countries started nuclear research in the 1960s, and they are expected to experience an upsurge of energy demands due to their rapid economic growth (IAEA, 2018). While Thailand is seeking to enhance their nuclear capabilities, Vietnam has completed the preliminary phase of nuclear energy development and announced the construction of two nuclear reactors by 2020. Although the construction plan was cancelled

in 2016 (Ngyuen and Ho, 2016), Vietnam is at a more advanced stage in nuclear energy development as compared to Thailand.

1.1.1. Thailand

Thailand has a population of appropriately 69 million over a land area of 513,150 km2 (United Nations [UN], 2017). As one of the largest producers and consumers of natural gas in SEA (IAEA, 2018), Thailand has predominantly relied on natural gas for electricity generation. However, Thailand has been exploring other energy alternatives, such as coal, hydropower, renewables as well as nuclear (Janssen, 2015) as the natural gas reserves in the Gulf of Thailand are estimated to exhaust in a decade (Routers, 2014).

To assess the feasibility of incorporating nuclear into the national energy mix, Thailand has conducted nuclear research for the past few decades. The country began nuclear research with the region's first research reactor in 1962 (WNA, 2016). However, Thailand's' plans for nuclear energy development were accelerated by the depletion of natural gas and surging electricity demands (IAEA, 2018). In 2007, the National Energy Policy Council (NEPC) ordered relevant governmental agencies to develop a plan for nuclear utility. In 2010, Thailand completed the pre-project tasks: According to IAEA's infrastructure review, Thailand is ready to start planning the employment of nuclear energy (IAEA, 2018). While there are no commercial nuclear power plants in operation or under construction, Thailand has prepared nuclear development plans and conducted numerous financial and technical assessments (Hopkins, 2016). Thailand is reportedly seeking China for technical support to achieve capabilities in nuclear energy development by the 2030s (Iwamoto, 2016).

However, Thailand's nuclear plans have been stalled due to public's skepticism and opposition (Hopkins, 2016). The Fukushima nuclear disaster and the concerns raised by IAEA regarding Thailand's readiness for nuclear development have also fueled public apprehension about the impending nuclear advancement (Paweewun, 2011). While anti-

nuclear campaigns have been occurring in the country, the current Thailand Power Development Plan (PDP) 2015 includes construction projects of two new nuclear reactors. They are expected to begin construction by 2029 and to start operation in 2035 and 2036 (IAEA, 2018).

1.1.2. Vietnam

Vietnam has a population of over 95 million and occupies a land area of 330,967 km2 (UN, 2017). Vietnam has traditionally relied on hydropower due to its abundant water resources (IAEA, 2016). However, in recent years, the government has included coal and gas-fired power plants to the grid to meet rising energy consumption. Coal and gas-fired power plants have been main energy sources for electrical generation in Vietnam (IAEA, 2016).

While Vietnam began nuclear research in 1963 (WNA, 2017a, 2017b), the increasing domestic demand for energy has catalyzed plans for nuclear energy development. In 2006, Vietnam launched the Strategy for Peaceful Utilization of Atomic Energy, which outlined the country's roadmap to develop and deploy nuclear energy by 2020. In 2009, the Vietnamese National Assembly approved the government's plans to build two nuclear power reactors in the Ninh Thuan Province, central Vietnam (IAEA, 2016). These plans involved site preparation, workforce training, and the creation of a legal framework to support the nuclear development plans. In 2014, Vietnam announced plans for the region's first nuclear power plant construction to commence in 2020 (WNA, 2017a, 2017b). The government faced public protests only sporadically; for example, by the Muslim minority of Cham in the Ninh Thuan province, and by local authorities of Dalat (Thränert, 2015).

However, these nuclear plans took a turn in recent years. In November 2016, the National Assembly decided to cancel the construction plans of the nuclear power plants due to decreased energy demand projections, soaring financial costs and growing safety concerns

(Ngyuen and Ho, 2016; WNA, 2017a, 2017b). There are currently no ongoing plans for constructing nuclear power plants in Vietnam.

2. Literature review

Past research on public perceptions of nuclear energy has predominantly examined the factors affecting public acceptance of nuclear energy. These studies have consistently demonstrated that public perceptions of benefits and risks, as well as their trust toward stakeholders (Kim et al., 2014) can influence the public's general acceptance of nuclear energy. Therefore, the current study intends to understand the extent to which the aforementioned considerations prevail in Thailand and Vietnam.

2.1. Benefit perceptions

Based on existing literature, most of the benefits associated with nuclear energy can be categorized as economic or environmental benefits. Economic benefits include energy security, high electrical output, and cost competitiveness of generating power (WNA, 2015). The environmental benefits primarily revolved around reduced ecological footprints, such as promoting sustainability and lower carbon emission (de Groot and Steg, 2010).

Past studies found that higher levels of perceived benefits increased the likelihood of public acceptance of nuclear energy (Tanaka, 2004). Increased benefit perception also reduced opposition against nuclear energy (de Groot and Steg, 2010). While perceptions of economic advantages have been consistently associated with the acceptance of nuclear energy, perceptions of environmental advantages have shown mixed results in terms of predicting public acceptance of nuclear energy (Kim et al., 2014; Visschers et al., 2011). Teräväinen et al. (2011) found that environmental advantages contributed to increased public support for nuclear energy, but this only applied to countries with existing nuclear power plants. This study aims to understand benefit perceptions of nuclear energy in Thailand and Vietnam:

RQ1: How do the public in (a) Thailand and (b) Vietnam perceive the benefits of nuclear energy?

2.2. Risk perceptions

People tend to perceive nuclear energy as a dangerous technology as compared to other energy sources (Cha, 2000). These risk perceptions include the potential occurrence of nuclear accidents, health and environmental hazards, detrimental economic impacts, radiation leakage, and improper nuclear waste management (Keller et al., 2012; Parkhill et al., 2010).

Previous research has found that risk perceptions, along with benefit perceptions, shape public acceptance of controversial technologies such as nuclear energy (Drottz-Sjöberg and Sjoberg, 1990; Tanaka, 2004; Visschers et al., 2011; Visschers and Siegrist, 2013). In general, the more people perceive a certain technology to be risky, the less likely they would be to accept it (Pidgeon et al., 2008). This study therefore aims to understand people's risk perceptions of nuclear energy in Thailand and Vietnam:

RQ2: How do the public in (a) Thailand and (b) Vietnam perceive the risks of nuclear energy?

2.3. Trust in key stakeholders

Trust refers to people’s perceptions of individuals and entities, in terms of their abilities and intentions (Rousseau et al., 1998). Past studies have demonstrated that people are willing to accept being placed in a vulnerable position by trusted others (Mayer et al., 1995). Trust is a key concept in technology acceptance studies and trust is a multi-faceted concept that contains two dimensions (Siegrist et al., 2012). Earle et al. (2007) identified two core dimensions of trust: value-based trust and competence-based trust. Despite the ambiguity surrounding the concept (Siegrist, 2010), scholars concurred that trust consists of competence and non-competence elements (Oshita, 2018; Terwel et al., 2009).

In the context of nuclear energy, studies have shown that trust guides public

acceptance of nuclear energy (Greenberg, 2009; Oshita, 2018; Slovic, 1999; Tsujikawa, Tsuchida, and Shiotani, 2016; Visschers et al., 2011; Visschers and Wallquist, 2013; Whitfield et al., 2009). Previous studies suggested that high levels of trust toward nuclear scientists (Siegrist et al., 2000), nuclear plant operators (Siegrist and Cvetkovich, 2000), and nuclear regulatory agencies (Guo and Ren, 2017) all contributed to public's acceptance of nuclear energy.

Past studies also indicated that trust influences benefit perceptions (Visschers and Siegrist, 2012) and risk perceptions (Siegrist, 2000). Visschers and Siegrist (2013) observed that people's trust enhanced their benefit perceptions of nuclear energy. Along these lines, Berdahl, Bourassa, Bell, and Fried (2016) also showed that trust was negatively related to risk perceptions. To understand the salience of the concept of trust, we explored the Thai and Vietnamese public’s trust in relevant stakeholders as follows:

RQ3: How do the public in (a) Thailand and (b) Vietnam perceive trust toward various organizations related to nuclear energy?

2.4. Acceptance

The public acceptance of controversial technologies such as nuclear energy has garnered scholarly attention (e.g. Huijts et al., 2012; Wolsink, 2010; Wüstenhagen et al., 2007). Past studies have pointed out the importance of examining the type and the degree of technology acceptance (Kim et al., 2014; Wüstenhagen et al., 2007). Studies have identified three types of technology acceptance: socio-political, community, and market (Wüstenhagen et al., 2007). Socio-political acceptance refers to the public's general acceptance of a certain technology. At the socio-political level, people accept a particular technology relatively easily because it usually does not involve the careful consideration of potential detriments on people's lives or environments. However, when the acceptance shifts from general to specific levels, people recognize the difficulties of accepting a certain technology because it is

directly related to their own situation (Bell et al., 2005). This level of acceptance is referred to as community acceptance. The third type of acceptance, market acceptance, involves people's intentions and willingness to pay for the adoption of a specific technology. Scholars have discussed that the NIMBY (Not-In-My-Backyard) syndrome occurs where there are discrepancies between the socio-political and community acceptance (Bell et al., 2005; Wolsink, 2010). In the context of nuclear facilities, Tanaka (2004) found a significant gap between these two types of acceptance: General (socio-political) acceptance was guided by both risk and benefit perceptions. However, local (community) acceptance was only related to benefit perceptions.

Kim et al. (2014) criticized past opinion polls for not capturing the gradation between acceptance and rejection of nuclear energy. Past research has identified a large segment of the in-betweens, those who reluctantly accepted nuclear energy (Bickerstaff et al., 2008). Many people seemingly accepted nuclear energy without a strong attachment. Therefore, their perceptions are susceptible to political and environmental changes (Kim et al., 2014). Bickerstaff et al. (2008) revealed that people accepted nuclear energy to mitigate climate change, considering that it was better than doing nothing. Similarly, the public tend to accept nuclear energy if they believe that the country has no alternative energy sources (Corner et al., 2011; Pidgeon et al., 2008). Our analyses on the Thai and Vietnamese public's acceptance of nuclear energy were guided by the following research question:

RQ4: To what extent does the public accept or reject nuclear energy in (a) Thailand and (b) Vietnam?

3. Method

3.1. Qualitative approach

This study seeks to provide an in-depth exploration of how the lay public in Thailand and Vietnam view their country’s civil use of nuclear energy in relation to their perceptions

of benefits, risks and trust toward relevant stakeholders, rather than to test a theory or model about public perceptions of nuclear energy. Therefore, this study adopted a qualitative approach, specifically FGDs, to examine our research questions. FGDs serve as an ideal method to elicit in-depth and personal discussions to obtain insights from multiple perspectives regarding a controversial issue, such as the use of nuclear energy adoption (Liamputtong, 2011). The focus groups were conducted until we observed substantial consistency in participants' responses, which suggested that a saturation of ideas had been achieved (Guest et al., 2006; Morse, 2000). This saturation of ideas bolstered our confidence that our FGDs provide a solid understanding of how people in Thailand and Vietnam perceive nuclear energy at the time of the FGD sessions. These FGDs also serve as an effective method to gauge public opinion as they closely mirror people's everyday conversations. Indeed, the effectiveness of FGDs to examine the topic of nuclear energy had been supported by earlier studies (Ho et al., 2018a, 2018b, 2019; Lock et al., 2014).

3.2. Sampling and recruitment

We conducted six FGD sessions in November 2016, in Bangkok and Hanoi, the capital cities of Thailand and Vietnam respectively. Research team members, local moderators, and participant recruiters were responsible for participant recruitment. Some of the moderators possessed research experience, and a briefing was conducted to ensure that recruiters were aware of the required participant profile. A mixture of convenience and purposive sampling was utilized. Recruiters used techniques such as word-of-mouth, posters, and public platforms to reach out to potential participants. In addition, only citizens and permanent residents of Thailand and Vietnam who possessed a minimum of secondary/high school education were invited to participate in the focus groups. This requirement was put in place as this study is interested in understanding what long-term residents of Thailand and Vietnam who hold voting power perceive about nuclear energy adoption. This requirement

also sought to ensure that participants possessed sufficient levels of science knowledge to contribute to the discussions, and would not conflate nuclear energy with nuclear weaponry. Moreover, the focus groups also consisted of an equivalent gender distribution to minimize gender bias across all groups.

In total, we recruited 54 participants aged between 18 and 69 years old[1] (M_{Thailand} = 37.24, SD_{Thailand} = 13.17; M_{Vietnam} = 36.92, SD_{Vietnam} = 12.85). We held three FGD sessions in each country. To encourage free-flowing discussions, participants in each country were divided into three groups according to their age. The age group was determined based on Pew Research Center's (2016) definition of generation. Table 1 provides details of the FGD sessions.

[Insert Table 1 about here]

As for gender, 34.5% of the Thai participants and 48% of the Vietnamese participants were male. The Thai participants consisted of 96.4% Thai and 3.6% Chinese. All Vietnamese participants belonged to the Kinh ethnicity. Prior to the start of each FGD, participants signed the informed consent form. Each FGD session lasted roughly 1.5–2 h. Upon completion of each session, participants received a compensation of THB 450 in Thailand and VND 44,000 in Vietnam for participating in the discussion.

3.3. Moderation

To ensure that participants could freely express their feelings and opinions, all FGD sessions were conducted in the local languages: Thai and Vietnamese. For the sessions in Thailand, we hired a moderator who is fluent in both Thai and English. The Thai moderator holds a doctoral degree in Communication. A Thai-national assistant moderator from a local university was also present to take notes and facilitate the discussion. This also ensured that

[1] The minimum voting age in Thailand and Vietnam is 18 years old. This study required the participants to be at least18 years old, as they would have voting power to influence policy decisions on nuclear energy development.

all topics were comprehensively covered and that each participant had an equal opportunity to speak out. For the FGDs in Vietnam, we recruited a graduate student from a Vietnamese university, who was well-versed in Vietnamese and English, to moderate the sessions. A Vietnamese-local who obtained a college degree served as the assistant moderator.

To ensure that the FGDs were conducted in a consistent manner, our research team briefed the moderators and assistant moderators about standardized FGD procedures and provided them with a semi-structured moderator's guide in English and their native languages. The moderator's guide consisted of a predetermined list of questions and prompts that were consistent across both countries. Before the FGD sessions, the moderators would interact with the participants to gauge their outspokenness. They would then arrange the seating positions of participants to achieve optimal results. For instance, quiet participants would be arranged facing the moderators to enable eye contact to encourage participation, while the dominant participants would be placed beside the moderator so as to allow the moderators to have greater control over their participation. During the session, the moderators facilitated the discussions in accordance to the moderator's guide and prompted for elaborative responses. In all FGD sessions, an assistant moderator was in charge of note-taking and recapping key points as a conclusion to the FGD session.

3.4. Analysis

The FGDs were transcribed verbatim and translated from local languages to English by the moderators and assistant moderators. Members of our research team, who are fluent in English and the local languages, examined the translated transcripts to verify that the transcripts were accurately translated. To ensure participants' confidentiality, the names of the participants in the transcripts and quotes in this manuscript have been replaced with alphanumeric codes. All identifiable information was also removed.

The translated transcripts were analyzed by two coders using the NVivo software.

This study employed a hybrid approach comprising of deductive and inductive coding: First, coders analyzed the transcripts using primary coding themes, which were derived through discussion among the research team. While analyzing the transcripts, coders also explored the inductive themes emerging from the data. This coding process revealed both primary and emergent themes located within the narratives. Both primary and emergent themes were adopted based on the repeated patterns and the connection to our research questions (Berdahl et al., 2016; Braun and Clarke, 2006).

4. Results

After reviewing most commonly discussed topics, four key themes emerged from the data: participants' perceptions of benefits and risks regarding nuclear energy, trust in relevant stakeholders, and their acceptance of nuclear power plants. These four themes were specifically instructed as main discussion topics in the moderator's guide. The following section uses alphanumeric codes to specify FGD sessions and participants for privacy reasons. Table 1 shows the corresponding codes for each country and age group. The letter "P" stands for participants. For example, "T1P6" refers to participant number 6 in the Thai 18–34 year-old FGD session. Although the participants were segregated by their age groups, there were no significant intergenerational differences across the key themes and sub-themes. The only difference lie in the types of examples that participants cited to elucidate their viewpoints. The key observations are depicted in Table 2.

[Insert Table 2 about here.]

4.1. Benefit perceptions

In both Thailand and Vietnam, the majority of participants often associated benefits of nuclear energy with national development. Contrary to past studies that were conducted in developed countries such as Europe and North America (e.g. Visschers et al., 2011), the benefit of mitigating climate change attracted little attention from the Thai and Vietnamese

participants. However, many participants did recognize the environmental advantage of nuclear energy. They also perceived nuclear energy as a technological breakthrough that could change their lives.

4.1.1. National development

The majority of the participants in both countries highlighted national development as a key benefit of nuclear energy. Many of them perceived nuclear energy as a form of development would contribute to societal progress (e.g. T1P10, T3P2). They also described nuclear energy as a stimulus that could boost economic growth (e.g. V1P1) and contribute to the development of "high-quality human resources" (V1P8). Notably, the Vietnamese participants expressed these types of benefits more explicitly than their Thai counterparts. The Vietnamese participants in the youngest age group felt that nuclear development provided a new opportunity for advanced science education.

4.1.2. Electrical generation

Related to national development, participants in both countries considered the large volume of electricity generated by nuclear power plants to be the primary benefit of nuclear energy (e.g. T3P2, V1P6). Vietnamese participants mentioned the advantage of stable electricity generation based on their personal experience, noting that they experienced blackouts every few days during the dry season (e.g. V1P4). In both countries, the participants deemed nuclear power plants to be a solution for the rising energy demands (e.g. T2P1, V2P1). Across all age groups in both Thailand and Vietnam, the participants concurred that nuclear energy would produce more electricity than existing resources, such as fossil fuels and hydropower.

4.1.3. Environmental benefits

While participants recognized the environmental advantages of nuclear energy, they mostly highlighted local or regional benefits such as reduced pollution and deforestation (e.g.

V3P6). They perceived environmental benefits within the context of their daily lives, including improved air and water quality (e.g. T2P2, V3P3). Phrases such as “global climate change” or “global warming” did not appear in FGDs except for V3 (the oldest generation group in Vietnam). In both countries, environmental benefits were discussed more often among the older participants than younger participants. In comparison, the younger participants identified national development as a primary benefit of nuclear energy.

4.1.4. Nuclear energy as a technological breakthrough

Some participants had high expectations that nuclear energy could change their lives. In Vietnam, participants expected the added source of electricity from nuclear power plants to break up the monopoly of the state electricity utilities company, Electricity of Vietnam (EVN), so that the price of electricity would decline (e.g. V1P2, V2P1). However, in reality, EVN would be tasked to manage and operate the newly constructed nuclear power plants (Ngyuen and Ho, 2016). In Thailand, participants in the youngest group considered nuclear energy as a panacea for all the energy issues. They perceived nuclear energy to be a guarantee to an inexhaustible supply of electricity that can be relied on indefinitely (e.g. T1P9, T1P10). These high expectations for a breakthrough were clearly not observed among the participants from the oldest age groups (T3 and V3).

4.2. Risk perceptions

In terms of risk perception, most Thai and Vietnamese respondents associated nuclear energy with nuclear accidents, environmental hazards, weaponization of nuclear energy, and political conflict, which echoed findings from previous studies in the developed countries (e.g. de Groot and Steg, 2010).

4.2.1. Nuclear accidents

In both Thailand and Vietnam, the participants across all age groups unanimously mentioned nuclear accidents as a potential risk of nuclear energy. The Chernobyl and

Fukushima disasters were frequently cited to demonstrate the difficulty of eliminating the potential risks of nuclear accidents (e.g. T3P3, T3P8, V1P2, V1P3, and V3P1). Many participants shared their fear of the severe and long-lasting effects that radiation could have on human health (e.g. T1P9, T3P7, and V2P4). They also stated that the invisibility of radiation exacerbated this fear (e.g. T1P6, T1P12).

In Thailand, multiple participants raised concerns about the possible health hazards incurred from living in close proximity to nuclear facilities (e.g. T1P1, V2P4). They feared that radiation may "leak bit by bit" (T2P8) and residents near the plant may "have cancer" (T1P12) even when nuclear power plants are operating normally. For example, one Thai participant commented that people who live near nuclear facilities could face discrimination in marriage prospects because some people fear that exposure to radiation would prevent them from having healthy children (e.g. T2P1). These opinions demonstrated that the participants possessed misunderstandings about nuclear power plants. In fact, nuclear power plants emit a negligible amount of radioactive materials during operation, which does not negatively impact human health (Duke Energy, 2013; WNA, 2018a). These stigmatized perceptions or misconceptions of the risks associated with nuclear energy were not observed among the Vietnamese participants.

Our participants felt that nuclear accidents could be triggered by human errors and natural disasters. In terms of human errors, both Thai and Vietnamese respondents stated that their countries would be more prone to serious accidents due to human errors, as compared to other countries. In particular, the Thai participants were worried about the "carelessness of Thai people" (T1P5), while the Vietnamese felt that "Vietnamese [would] usually try to do things quickly and might drop some steps [*sic*] in the process" (V1P2). In terms of natural factors, several Thai participants (in T1 and T2) noted that the geographic condition of Thailand differed from that of most developed countries. They wondered whether nuclear

reactors could be overheated due to the high temperatures in Thailand, a stark contrast from the countries that have successfully implemented nuclear plants. Therefore, they pondered if the expertise of international nuclear professionals could be applied to the Thai context (e.g. T1P11). The Vietnamese participants also expressed concerns that frequent storms on the central coasts would affect the safety of nuclear power plants (e.g. V3).

Interestingly, some Vietnamese participants were optimistic about the potential risks of nuclear energy. They emphasized their trust toward nuclear scientists. One participant stated that although nuclear power plants currently entailed risks, they would be safer and more beneficial to the society in the future because scientists were working on a way to reduce risks (e.g. V1P8).

4.2.2. Environmental hazards

While participants in both countries recognized the environmental advantages of nuclear energy, they were also worried about the potential environmental risks that may arise from the construction and operation of nuclear power plants. Participants from T1 and V2 were concerned about how the construction and operation of nuclear power plants may negatively affect the country's biodiversity. Participants from T1, T2, and V2 also raised concerns regarding nuclear waste management. Some participants claimed that scientists had not found a solution to manage nuclear waste (e.g. T2P4, V2P9), while, in reality, safe methods for nuclear disposal have been in operation in advanced countries such as the United States (WNA, 2017a, 2017b). The participants from the oldest age groups (T3 and V3) addressed environmental benefits, but they did not mention how the management of nuclear waste could be an environmental risk.

4.2.3. Weaponization

Although our moderators explained that the topic for discussion was nuclear energy and not nuclear weapons, most participants in all age groups repeatedly associated nuclear

energy with nuclear weapons such as atomic bombs (e.g. T1P11, V1P4). In both countries, the risks of converting nuclear technology and facilities to destructive forms were mistakenly articulated. For example, one Thai participant said that the construction of nuclear power plants in Thailand would heighten the threat of terrorism: “Currently, Thailand cannot even control terrorist problems in the South and also in Bangkok. And now, you want to add one more weakness [*sic*] to it by building a nuclear power plant?” (T2P2). However, weaponizing nuclear energy facilities is practically impossible since it requires more advanced technology (Levi, 2011; Marder, 2011; WNA, 2018b).

The Vietnamese participants also feared the potential weaponization of nuclear energy. However, some participants mentioned that having a nuclear reactor within the country could bring about benefits in a radical tone: “If someone comes, we can just make the nuclear power plant explode and they will die with us” (V2P1). Another participant shared such sentiments by remarking that: “It would be great if we can develop nuclear energy and nuclear weapons too. We can scare them [other countries] away” (V2P5). We did not identify this type of sentiment among the Thai participants. While we cannot provide definite explanations on this regard, the Vietnamese participants’ historical background and current conflicts with neighboring countries might be a reason behind their statements on the weaponization of nuclear energy.

4.2.4. Political conflict

Across all the FGDs, the Thai participants perceived the possibility of political conflict over the construction of nuclear power plants as a risk (e.g. T1P11, T2P4, and T3P2). They felt that promoting nuclear energy development could create political instability, such as disputes over the site selection for nuclear facilities. Since Thailand has been suffering from declining financial investments due to the decade-long political disturbance (Lee Arpon, 2017), the Thai participants were more concerned about political conflicts as a result of

nuclear energy development more than the Vietnamese. In fact, such concerns were not observed in the Vietnamese FGDs.

4.3. Trust in potential key stakeholders

4.3.1. Governments

Participants across all age groups in Thailand and Vietnam expressed low levels of trust in their governments. They attributed this lack of trust to the government's low levels of nuclear-related expertise (e.g. T1P1, T2P7, and V1P3). Many participants said their countries have not achieved sufficient capability to handle nuclear power plants. Participants in both Thailand and Vietnam also perceived a lack of competency in their compatriots. For example, Thai participants said the Thais were “sloppy” (T1P10) and Vietnamese participants described themselves as “careless” (V1P2). In Vietnam, participants also referred to a past accident at a steel plant and the government’s mismanagement of hydro power plants to exemplify the lack of capability (e.g. V1P2, V2P1).

The Thai participants also did not trust the Thai government as they felt that their government lacked transparency (e.g. T1P11, V2P1) and concealed important information (e.g. T1P10). The Thai participants also believed that corrupt government officials could “intervene” (T2P4) in the decision-making process (e.g. T1P10, T2P2, and T3P8). Similarly, the Vietnamese participants felt that the government were likely to “hide bad news” (V3P1). For example, our Vietnamese participants claimed that they were not fully informed of the National Assembly’s decision to cancel the nuclear plant project in Ninh Tuan (e.g. V3P4).

4.3.2. Nuclear scientists

In contrast, participants in all FGDs expressed unconditional trust toward nuclear scientists. Particularly in Vietnam, participants supported scientists’ decision on plant siting because “[nuclear scientists] have done many surveys and calculations” (V2P1) and laypeople “cannot think better than them [nuclear scientists] [*sic*]” (V2P9). Participants in

both countries also preferred foreign and international scientists because the participants felt that they would be more transparent (e.g. T1P3, V1P4). Both Thai and Vietnamese participants believed that the international nuclear scientists possessed greater expertise than local scientists because the international scientists were more experienced (e.g. T1P2, V3P4). None of the participants mentioned that scientists' calculation of risks, safety, and profitability could be affected by their political and economic interests: Participants assumed that scientists would exclude themselves from the world of politics. Participants also showed high levels of trust in scientists, probably due to their perception that scientists are indifferent to political decisions, in contrast to the respective local government.

4.3.3. Foreign and international entities

Our participants in both countries held high levels of trust toward foreign and international organizations to manage nuclear power plants. No significant differences were observed based on generations. However, their feelings toward these organizations were quite complicated. While participants in both countries did not think their governments had enough expertise to operate nuclear power plants, many participants wanted their governments to be involved in the nuclear operation, because they felt that the foreign and international entities might have "no love for us" (T2P2) and they would not consider the locals "as their first priority" (T2P2). Both Thai and Vietnamese participants were also worried of being exploited by international or foreign entities (e.g. T3P2, V1P6).

4.4. Acceptance of nuclear energy development

4.4.1. "Not ready yet"

While many participants in Thailand and Vietnam felt that the benefits of nuclear energy outweigh its risks, they did not support the building of nuclear power plants in their countries (e.g. T3P8, V3P2). These participants believed that their countries were "not ready" (V3P4). In Thailand, participants stated that the Thais did not possess sufficient knowledge

about nuclear energy, and the development of nuclear energy would create public confusion (e.g. T3P2). The Vietnamese participants also opposed the building of nuclear power plants due to the country's perceived lack of expertise (e.g. V1P2). Overall, the participants preferred to defer the construction of a nuclear power plant in their countries until their countries have learnt enough from other countries about nuclear science and have cultivated sufficient local nuclear scientists and expertise in their homeland.

4.4.2. Strong support for nuclear research

In spite of their general opposition toward constructing a nuclear power plant, the participants in both countries unanimously agreed that it was necessary to fund research and promote public education of nuclear energy. This point was particularly highlighted by the Thai participants. They mentioned that people were unable to make informed decisions on whether they should accept nuclear power because they lacked the necessary information (e.g. T3P3). Both Thai and Vietnamese participants also stated that their countries needed research on nuclear power to educate people on how to effectively handle nuclear accidents and protect themselves from radiation and radioactive materials (e.g. T1P5, V3P5). Although the participants showed high levels of trust in nuclear scientists, they hoped to be informed about the technical details behind the evaluation of political decisions. This suggested that although participants trusted nuclear scientists with regard to their competency in handling nuclear technology, they prefer to rely less on scientists when it comes to decision-making about energy policy.

4.4.3. Keeping up with neighboring countries

Both the Thai and Vietnamese participants mentioned that their countries should develop nuclear power facilities if neighboring countries in SEA were to build nuclear power plants. One participant mentioned that it was important to jump on the bandwagon, "otherwise [we] will fall behind" (T1P7). Some participants also perceived winning the

regional race for nuclear energy development as an issue of national security (V1P4). Despite this, some participants insisted that nuclear energy development should be informed and determined by national needs (e.g. T3P4). These lines of argument were observed more commonly among the younger participants than the older participants in Thailand and Vietnam.

5. Discussion and study implications

5.1. Comparison with existing public opinion surveys in Thailand and Vietnam

The findings correspond largely with quantitative public opinion research conducted in Thailand and Vietnam. While the Thai participants in this study recognized the benefits associated with nuclear energy development, they generally opposed the construction of nuclear power plants. This sentiment was also evident in ABAC Poll Research Institute's public opinion poll, where 16.6% supported plans for constructing nuclear power plants in Thailand (Pongsoi and Wongwises, 2013). This trend was corroborated by our FGD findings, as participants were generally unsupportive of building a nuclear power plant in the country despite recognizing significant benefits associated with nuclear energy.

Meanwhile, the Vietnamese participants generally opposed nuclear energy development as they feared the potential occurrence of nuclear accidents. These attitudes were also reflected in a global opinion poll conducted by WIN-WIN-Gallup International (2011), where more than 70% of Vietnamese citizens were concerned about the possibility of a nuclear incident in Vietnam if the country decided to construct a nuclear power plant. Similar to our qualitative findings, the majority of the Vietnamese public expressed strong fear of nuclear accidents.

5.2. Theoretical implications

First, this study contributes to extant literature by providing an in-depth understanding of public perceptions toward nuclear energy development in less-investigated contexts, such

as countries in Southeast Asia (Ho et al., 2018b), namely, Thailand and Vietnam. This study can be a cornerstone for future public opinion research on nuclear energy in countries that are in the preliminary phases of nuclear energy development.

Second, this study contributes to scholarly discussions on the dimensionality of trust. The current study suggested that the perceived levels of stakeholder's competency and transparency were insufficient conditions to gain the public's trust. As seen from our participants' perceptions toward foreign and international entities, the stakeholder's perceived empathy toward the public is an essential dimension in people's trust. In other words, people expected the organization in charge of nuclear power plants to possess nuclear-related expertise, be transparent about operations, and show gestures that the organization share the same values and concerns with the public.

Third, our findings implied that economic benefits were a stronger impetus for people to accept nuclear energy than environmental benefits. Our respondents in Thailand and Vietnam viewed nuclear energy as a shortcut to advance economic and national development. Despite recognizing its environmental advantages, it was not raised as a reason to support nuclear energy. This corresponds to Teräväinen et al. (2011)'s research, which argued that only people in the countries with nuclear power plants appreciated the environmental benefits of nuclear energy development.

Finally, some participants formed opinions of nuclear energy development based on certain misconceptions that contradict scientific explanation and understanding. For example, several Thai participants misperceived that individuals who live within close geographical proximity to nuclear facilities will develop cancer due to harmful levels of radioactivity from the nuclear power plants. However, nuclear power plants do not emit a sufficient amount of radioactive materials to adversely affect human health (Duke Energy, 2013; WNA, 2018a). Some participants also believed that nuclear scientists do not have enough knowledge to

handle radioactive waste. However, the scientific community has reached international consensus on how to store and dispose radioactive waste from nuclear power plants (WNA, 2017b). Moreover, some Vietnamese participants held the misconception that the nuclear energy facilities for electrical generation could be easily used to create nuclear weapons. However, in reality, it requires more advanced technology and processes to convert the nuclear facilities for energy development to nuclear weapons (Levi, 2011; Marder, 2011; WNA, 2018b). These misconceptions therefore attest to how people's "top-of-mind associations" (Clarke et al., 2015, p. 133) or "affective imagery" (Keller et al., 2012, p. 466) played an important role in shaping their perceptions and discussion on nuclear energy.

5.3. Policy implications

The current study also provides practical implications regarding public communication of nuclear energy in SEA. First, the findings from this study may assist organizations on strategies that can be adopted to gain public's trust. Our study indicated that competence, transparency and empathy were important dimensions in people's trust. Therefore, in public communication endeavors, organizations in charge of nuclear energy should (1) highlight their expertise, (2) communicate in an open and honest manner, and (3) emphasize the values and concerns shared with the public.

Second, the findings provide indications on the types of benefits associated with nuclear energy that people are likely to pay attention to. Our study revealed that people predominantly focused on practical and personally-relevant matters regarding nuclear energy such as economic benefits. Therefore, policymakers and communication practitioners in Thailand and Vietnam could highlight benefits of nuclear energy, which are directly related to people's lives, such as a stable electricity supply and lower electricity bills. By using message framing in public communication efforts (Tankard, 2001), the governments and communication practitioners could emphasize how nuclear energy can provide a stable

electricity supply and lower electricity bills for their citizens. If environmental benefits were to be used as a potential benefit-frame to advocate nuclear energy development, it should be explained in terms of its direct impact on people's lives. Furthermore, since some of the participants also regarded nuclear energy development in neighboring countries as a threat to their country's national security, it is also crucial for the policymakers to provide constant updates on regional nuclear development to their citizens. This approach could prevent baseless public fear and assuage their feelings of anxiety toward nuclear energy.

Third, the findings of this study highlighted the importance of dissolving misperceptions of nuclear energy by distributing accurate information on risks and benefits to the public. It is also important to debunk inaccurate information even on non-news format materials, since such information may foster misconception about nuclear energy among the public (Horlick-Jones et al., 2007; Myers, 2007). Since these stigmatized perceptions, or misconceptions can impede public discussions of nuclear energy development, it is crucial to address the misunderstandings of the risks and benefits of nuclear energy on a national scale. Moreover, the current study has shown that people need to perceive themselves as being fully informed in order to trust the possible stakeholders of nuclear energy and accept the controversial technology. Communication outreach to increase public trust and accurate understanding of nuclear energy should be considered as a foundation of nuclear development.

Finally, the current study suggested that cultural and political differences play a crucial role in influencing public attitudes toward nuclear energy. While we generally observed similar attitudes toward nuclear energy in Thailand and Vietnam, we also found subtle but striking differences between the two industrializing nations. For example, Thai participants expected the government to conduct more public information campaigns on nuclear energy. They were particularly worried about political disturbance as a result of

nuclear development plans. In contrast, Vietnamese respondents considered nuclear energy as part of national security. They wanted their government to conduct more nuclear research and enhance nuclear capability to handle nuclear energy. Such differences could influence political decisions on nuclear energy.

5.4. Limitations and directions for future research

As this study recruited participants that completed at least secondary-level education, the findings may not be representative of Thai and Vietnamese nationals with no formal education or primary-level education. Although this approach limited the generalizability of this study's findings, it ensured that the participants had sufficient nuclear knowledge to articulate their viewpoints and engage in a conversation with other participants. Moreover, the focus group sessions in Thailand and Vietnam were conducted in highly urbanized cities. Since individuals residing in rural areas may have starkly different lifestyle, knowledge, and attitudes, the findings of this study may not be generalizable to suburban populations. While educated populations in urban areas tend to exert more influence on energy policy (Leighley, 1995; Thananithichot, 2012), future research should pay attention to the rural and less-educated populations as well, to reflect their opinions during the policy-making process. Considering the fact that nuclear power plants have been commonly built in rural areas (IAEA, 2012), it is important for policymakers to engage the segment of the population in policymaking regarding nuclear energy. Future research should address how policymakers can communicate with the less educated populations in rural areas about the benefits and risks of nuclear power plants.

The fact that we employed a qualitative approach also means that we would not be able to generalize the findings retrieved from the data. Nevertheless, we observed substantial consistency in participants' responses, which suggested this study achieved a saturation of ideas in the FGDs (Guest et al., 2006; Morse, 2000). This saturation of ideas increases

confidence that our FGDs provide a solid understanding of how people in Thailand and Vietnam perceive nuclear energy at the time of the FGD sessions.

While our findings are exploratory by nature, they still provide important suggestions about the possible directions for future research. First, the findings obtained in this study should be tested and discussed using quantitative approaches (e.g., nationally-representative surveys) for further generalizations. Second, future studies can include other SEA countries such as Malaysia and Indonesia to depict the overall picture of perceptions of nuclear energy in SEA. Third, future studies can include industrializing countries in other regions such as the Middle East and Africa, which are also considering nuclear energy development. Future studies examining these countries would be able to reveal what aspects are unique to SEA and what are common among industrializing countries. A comparative study could reveal how public perceptions concur or differ across countries at varying stages of nuclear energy development.

6. Conclusion

In conclusion, this study highlights the similarities and differences in how Thais and Vietnamese perceive the risks and benefits of nuclear energy, their acceptance of nuclear energy, and their levels of trust in key potential stakeholders in handling nuclear power plants. It also revealed the misconceptions that the public hold regarding nuclear energy. This could inform public communication strategies of nuclear-related information to laypeople, and facilitate public education of nuclear energy.

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Appendix

Tables

Table 1
Compositions of focus groups in Thailand and Vietnam.

Group Name	Country	Age	No. of participants
T1	Thailand	18-34	12
T2	Thailand	35-50	8
T3	Thailand	51-69	9
V1	Vietnam	18-34	10
V2	Vietnam	35-50	9
V3	Vietnam	51-69	6

Table 2.
Summary of Findings

		Thailand	Vietnam
Benefit perception		- Electricity generation - National development (e.g., societal progress; economic growth) - Environmental (e.g., less pollution; improved air quality)	- Electricity generation - National development (e.g., societal progress; economic growth; educational opportunities) - Environmental (e.g., less pollution; improved air quality; improved water quality; less deforestation)
Risk perception		- Accidents - Environmental hazards (e.g., nuclear waste) - Weaponization - Political conflict	- Accidents - Environmental hazards (e.g., nuclear waste) - Weaponization
Trust in stakeholders	***Government***	- Low expertise - Low in transparency	- Low expertise - Low in transparency
	Scientists	- High expertise	- High expertise
	Foreign and international entities	- High expertise - Low in empathy	- High expertise - Low in empathy
Acceptance		- Not ready for nuclear energy adoption	Not ready for nuclear energy adoption

Note: The items are arranged in a descending order of importance.